effect of curves involving changes of direction of the road, the velocity of the transit, and the distance between the rails; but, for the reason already stated, not comprising the radii of the curves.

Although the radii of the curves do not form a constant element of the estimate of the mechanical power necessary to work the road, nevertheless they are of material consequence, as far as regards the safety of the transit. Although a short curve with a great resistance may be moved over with the same expenditure of mechanical power as a long curve with a long radius, yet, owing to the intensity of the pressure of the flange against the rail, the danger of the trains running off the road is increased: hence, although sharp curves cannot be objected to on the score of loss of power, they are yet highly objectionable on the score of danger.

In the present paper, the author has confined himself to the analytical formulæ expressing various mechanical effects of the most general kind; the coefficients and constants being expressed merely by algebraical symbols: but he states that he has made an extensive series of experiments within the last few years, and has also procured the results of experiments made by others, with a view to determine the mean values of the various constants in the formulæ investigated in this paper. He has also, with the same view, made numerous observations in the ordinary course of transit on railways; and he announces his intention of soon laying before the Society, in another paper, the details of these experiments, and the determination of the mean values of these various constants, without which the present investigation would be attended with little practical knowledge.

A paper was also read, entitled "Register of the State of the Barometer and Thermometer kept at Tunis, during the years 1829, 1830, 1831 and 1832." Presented by Sir Thomas Reade, His Majesty's Agent and Consul General at Tunis. Communicated by P. M. Roget, M.D., Sec. R.S.

The observations here registered are those of the thermometer at 9 A.M., at noon, and at 6 P.M., and the points of the wind, and height of the barometer for each day of the abovementioned years.

May 5, 1836.

FRANCIS BAILY, Esq., Vice-President and Treasurer, in the Chair.

Edward Burton, Esq., William Sands Cox, Esq., and Captain Thomas Locke Lewis, R.E., were elected Fellows of the Society.

A paper was in part read, entitled "On the Optical Phenomena of certain Crystals." By Henry Fox Talbot, Esq., F.R.S.

May 12, 1836.

The Rev. WILLIAM WHEWELL, M.A., Vice-President, in the Chair.

The reading of a paper, entitled "On the Optical Phenomena of

certain Crystals," by Henry Fox Talbot, Esq., F.R.S., was resumed and concluded.

In this memoir the author gives an account of the optical properties of certain minute crystals, obtained by the evaporation of a solution of borax in phosphoric acid, exhibited when they are examined by means of the polarizing microscope. The field of view is then seen covered with minute circular spots, each composed of a close assemblage of delicate acicular crystals, radiating from the centre; together with other circular bodies, in which this disposition is not observable, on account of the close union of the component crystals, which, producing optical contact, gives perfect transparency to the whole mass. When the field of view is rendered dark by the rectangular crossing of the polarizing laminæ, each of these little circles becomes luminous, and exhibits a well-defined dark cross, dividing its area into four equal sectors. These crosses have a similar position in all the circles; and their direction remains unaltered when the crystals are turned round in their own plane, by causing the plate of glass, on which they are placed, to revolve.

On examining the larger circles with a high magnifying power, and under favourable circumstances of illumination, the author observed upon each a series of coloured concentric rings: but the number as well as the colour of these rings varies in different crystals. The innermost ring is deeply coloured, or black; and incloses a central space of white light, which is traversed by the arms of the cross, intersecting in the centre. This part of the cross, which stands within the innermost ring, is beautifully defined, and perfectly black. The whole system of phenomena are exactly analogous to that exhibited by uniaxal crystals; and corresponds still more closely with those discovered by Sir David Brewster in spheres of glass, the density of which had been rendered variable from the centre to the surface by immersion in heated oil; excepting that the miscroscopic crystals here described are possessed of a far more intense polarizing energy. The author thinks it probable that the phenomena are in both cases produced by similar conditions of density; which, in a circular mass formed by the aggregation of needle-shaped crystals radiating from a common centre, it is natural to suppose would rapidly increase from the circumference to the centre. By watching the progress of crystallization he ascertained that this was, in fact, the mode in which the crystals are constructed: for they frequently appeared, at first, in the form of lengthened prisms, which subdivided themselves at both ends into an immense multitude of divergent fibres, like those of a brush; apparently repelling each other as they extended in length, and occupying spaces corresponding to two opposite sectors of a circle; until, by spreading still farther in breadth, their edges united, and filled the whole of a circular area. In all the stages of this process, the formation of the black cross may be seen to keep pace with the developement of the crystal, until perfectly displayed on the completion of the crystalline structure. The author notices the analogy which this structure presents with that of the crystalline lens of the cod fish, as has been lately described by Sir David Brewster; and

also the remarkable correspondence existing between the optical properties resulting from this structure, and the phenomena of the circular polarization of fluids, which have been accounted for by the existence of molecules of a structure nearly similar.

The author proceeds to examine the action of these crystals in common, or unpolarized light; and concludes from his inquiries that each of their diameters polarized the light in the plane passing through itself and the direction of the ray; so that the whole emergent light consists of equal portions polarized in every plane, and according to every diameter of the circle. This action is similar to that which would be exerted by an assemblage of an infinite number of pieces of tourmaline cut into the form of infinitely small sectors, in the direction of the axis, and disposed as radii in a circle. The author considers it probable that the tourmaline itself is an aggregate of acicular crystals of this description, disposed in a direction parallel to its axis, and being in optical contact, as well as in perfect mechanical cohesion.

In a postscript to this paper, an account is given of a new species of Dichroism in crystals, to the discovery of which the author was led by applying to them his peculiar method of observation with polarized light. In these experiments the crystals themselves perform the office of the analysing plate, acting on light previously polarized, and transmitted through a plate of mica. Under these circumstances, the crystals of borax, described in the first part of the paper, when examined with a lens of moderate power, appear beautifully coloured with two complementary colours, according to the position of their axes. These experiments tend to confirm the views of Sir David Brewster and others as to the general cause of the dichroism of crystals, which is ascribed to a difference of absorptive energy in different directions with relation to their axes; arising from a difference of elasticity in these respective directions.

May 19, 1836.

RODERICK IMPEY MURCHISON, Esq., Vice-President, in the Chair.

A paper was read, entitled, "On the valuation of the mechanical effect of Gradients on a line of Railroad." By Peter Barlow, Esq., F.R.S.

The exact amount of the influence of ascents and descents occurring in the line of a railway on the motion of a load drawn by a locomotive engine having been differently estimated by different persons, the author was induced to investigate the subject. A few observations are premised on the erroneous assumptions which, he conceives, have in general vitiated the results hitherto deduced. The first of these is that the expenditure of power requisite for motion is equal to the resistance to traction; whereas it must always greatly exceed it. No account, he remarks, has been taken of the pressure of the atmosphere on the piston, which the force of the steam has to overcome before it can be available as a moving power. Another source of error has been that